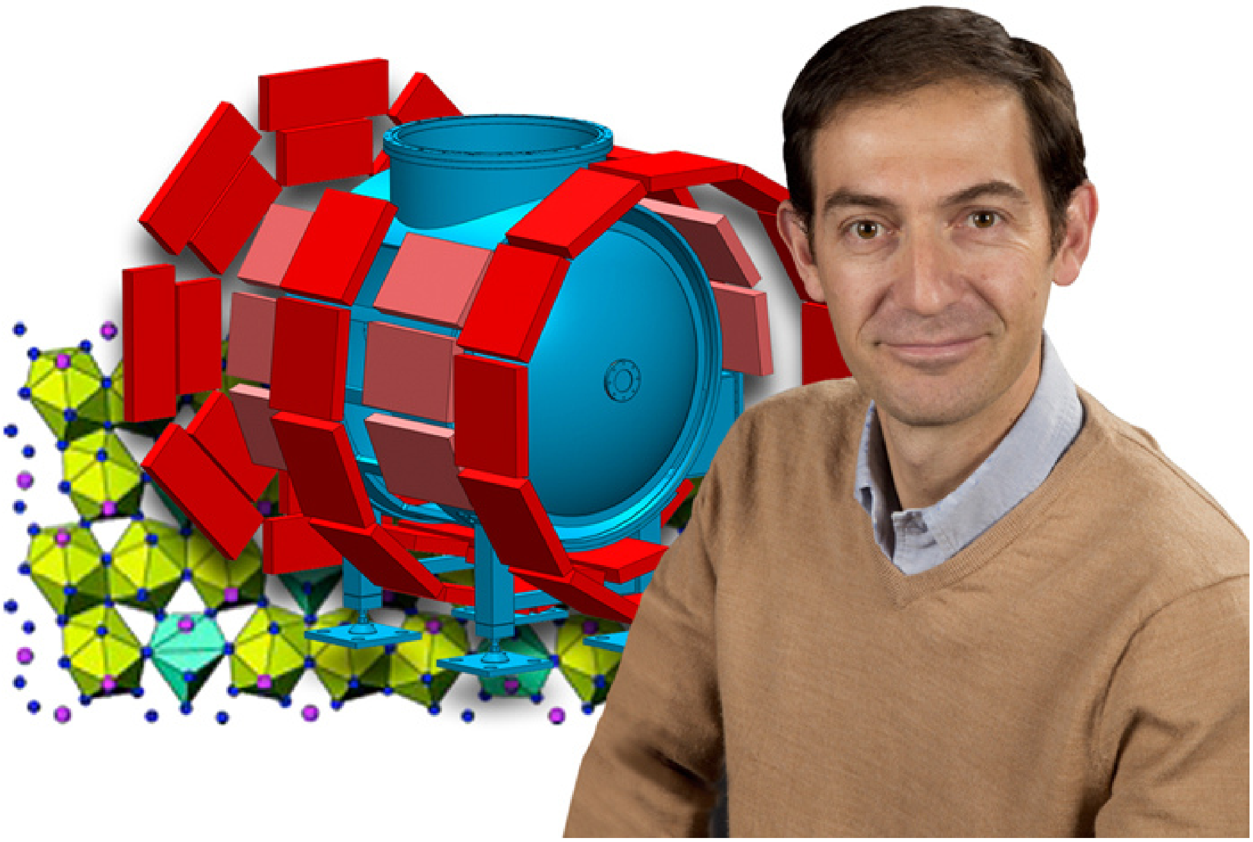
A crystallographer keen on showing off the revealing properties of neutrons

February 27, 2014



At Los Alamos's Lujan Neutron Scattering Center, crystallographer Olivier Gourdon shows visiting researchers some of the latest tricks that can be performed using this 100-year old multidisciplinary science, which has a spectacular record of demystifying materials as varied as DNA and Martian rocks."Crystallography has the image of an old science. I'm trying to refresh that," said Gourdon, an instrument scientist for HIPPO, the High-Pressure-Preferred Orientation Neutron Diffractometer.Since the 1914 Nobel Prize-winning discovery that crystals can scatter the light waves of x-rays, thereby revealing how atoms are arranged in matter, scientists have used x-ray crystallography to great effect.Neutron crystallography, a related experimental technique, debuted in 1946. Also known as neutron diffraction or neutron scattering, the method involves immersing samples in neutrons rather than x-rays. It tends to be underused, though, because generating neutrons requires a sophisticated infrastructure, such as at the Los Alamos Neutron Science Center (LANSCE).Gourdon (Lujan Center, LANSCE-

LC) is a proponent of both techniques as together they sometimes paint the most vivid picture of all. With HIPPO, he guides users through the process of bombarding ground-up crystals with intense neutron beams and afterward deciphering the data for high pressure-temperature, texture, liquid-amorphous materials, or reaction-kinetic studies.“With neutron diffraction, we can learn much more than where are the atoms. We can, in some conditions, understand the dynamics and the vibrations of some atoms,” Gourdon said. Neutrons, for instance, can determine the internal strains and structure of deformed metal, telling the story of why metals give before they break.He also encourages scientists to use the Lujan Center’s complementary techniques, not just crystallography. “There is not a magic instrument that will give all the answers,” he said.Gourdon first experienced neutron crystallography as a 2004 Lujan Center postdoctoral researcher supporting users on the new HIPPO instrument and studying magnetic structures and hydrogen storage materials. Next, as an Oak Ridge National Laboratory instrument scientist for its neutron powder diffractometer POWGEN, he investigated structure-property relationships in materials for energy sources, such as batteries and fuel cells. And at Pennsylvania’s International Centre for Diffraction Data, Gourdon built a materials database using neutron diffraction patterns as fingerprints and created software for diffraction data analysis.Longing to return to hands-on science, Gourdon rejoined the Lujan Center in September. “He is without a doubt an extremely valuable addition to the Lujan Center and the HIPPO user program in particular,” said HIPPO co-instrument scientist Sven Vogel, noting his former protégé’s expertise in modeling crystal structures, fabricating samples, and analyzing neutron diffraction data. “His previous tenure [at HIPPO and POWGEN] allowed him to immediately contribute to our program.”When the LANSCE beam is on–about half the year–Gourdon dedicates himself solely to users. “We see so many kinds of people and so many kinds of science,” he said. When the beam is off, he conducts energy-related research based on oxides and intermetallics. “Neutrons are more suitable than x-rays for studying batteries,” he said, “since this ray can screen lightweight and heavy elements simultaneously.”

Though Gourdon’s first love was mathematics, he earned a PhD in materials chemistry and structural chemistry from the University of Nantes in France. “At the end of the day, crystallography is geometry, so it’s math,” he said. “I am somewhere between mathematics, physics, and chemistry. That’s why the Lujan Center suits me well.”